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ABSTRACT

The present study was in part a case study involving the levels of use that existed among a sample of second- and fourth-grade teachers using or anticipating the use of individualized instruction in reading and mathematics instruction. The sample was assumed to include both users and nonusers of the innovation as half the schools were involved in individually guided education (IGE) and half were not. The study also explored the relationship between the level of use of an innovation and learning outcomes in students. The levels of use reported indicated that most users at one of two of the eight possible levels. It was also determined that some teachers in the IGE school were not using the innovation while some teachers at the non-IGE school were. The many analyses conducted indicate that there are significant differences in student achievement between teachers at different levels of use. (Author/IRT)

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AN EXPLORATION OF LEVELS OF USE OF AN INNOVATION AND THE RELATIONSHIP TO STUDENT ACHIEVEMENT

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AN EXPLORATION OF LEVELS OF USE OF AN INNOVATION AND THE RELATIONSHIP TO STUDENT ACHIEVEMENT[1,2,3]

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Introduction

The last two decades in education have been characterized largely by a proliferation of innovations in every conceivable area. A large number of these innovations have sought to alleviate educational ills in areas such as the inner city, among non-English speaking Americans, and to promote new ways of dealing with the massive amount of knowledge that is accumulating in the world today, such as through discovery learning and problem solving. But despite the massive research and development efforts of the 1960's and early 1970's, these problems still exist. Innovations are not in widespread use, or when in use, are often not used effectively. In Goodlad's (1970) words, they have been "blunted on the classroom door."

Why innovations have not been more successful is a question that is just beginning to receive attention, particularly as the dollars allotted to development of more innovations have dwindled (Gross, Giaquinta, & Bernstein, 1971; Miles, 1964). The problem has been approached by two major groups, as revealed in the literature. The first, those involved in research and theory-building in the area of educational change, have sought to conceptualize the change process and to examine its characteristics and potentialities (Havelock, 1971; Rogers & Shoemaker, 1971). The second, educational evaluators, have sought to specify the nature of the new products and programs being used and to relate these to student outcomes (Scriven, 1967; Stufflebeam, 1971).

Many variables have been identified that influence innovation implementation, including amount of resources available, social class of the school population,

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[1]A more in-depth report of this study, including the reporting of results of statistical tests, can be ordered from Communication Services, Research and Development Center for Teacher Education, the University of Texas, Austin 78712.

[2]Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April 20, 1976, session 6.14.

[3]The research described herein was conducted under contract with the National Institute of Education. The opinions expressed are those of the authors and do not necessarily reflect the position or policy of the National Institute of Education and no endorsement by the National Institute of Education should be inferred.

and the nearness of assistance to the innovation users (Rogers & Shoemaker, 1971). Other variables that are thought to be significant to innovation implementation are dimensions of the Concerns-Based Adoption Model (CBAM) (Hall, Wallace & Dossett, 1973), a model of innovation adoption currently under study at the Research and Development Center for Teacher Education at the University of Texas at Austin. The CBAM focuses on the individual as s/he progresses through the process of innovation adoption. Two dimensions are described: (1) the concerns expressed by innovation users, defined as seven Stages of Concern About the Innovation, and (2) the behaviors demonstrated by innovation users, defined as eight Levels of Use of the Innovation. The Levels of Use (LoU) dimension (Hall, Loucks, Rutherford & Newlove, 1975) is particularly useful for focusing on innovation implementation, describing individuals from their initial involvement in learning about an innovation through highly sophisticated, integrated use. Figure 1 describes the eight levels.

If innovation implementation is to be more effective than it has been in the past, the first step is to be able to describe and measure innovation use. This is where Levels of Use can be most helpful. What is the "state of the art" of implementation of a particular innovation in a particular school or school district? If the principal says all the teachers are using a particular new program, can it be assumed that they all use it with the same quality, or indeed, that they are each using it at all? If Level of Use is determined for each teacher, a profile can be drawn of a school or school district's use of the innovation, thus providing information useful to supervisors, administrators, staff development people and evaluators, anyone interested in facilitating or assessing innovation use.

The present study was in part a case study involving the Levels of Use that existed among a sample of second- and fourth-grade teachers using or anticipating the use of two innovations. These innovations were individualized instruction in reading and individualized instruction in mathematics. The sample chosen was assumed to include both users and nonusers of these innovations, since half the schools were involved in the use of Individually Guided Education (IGE), a program to facilitate individualization, and half were not.

Another question this study chose to explore involves the relationship between a teacher's Level of Use of an innovation and learning outcomes for his/her students. The principal reason for developing and implementing innovations is to increase learning outcomes, whether they be cognitive, attitudinal, performance, etc. It is therefore hoped that students of teachers using a particular innovation have greater learning outcomes than students of nonusers. There is also an implicit assumption in the Level of Use sequence that students of teachers at higher Levels of Use should achieve more than those of teachers at lower Levels of Use. To explore these assumptions, comparisons were made of student achievement for users vs. nonusers of individualized instruction and for teachers at different LoU's. The effect of variables such as IGE and Title I (an indication of low SES) was explored.

The remainder of this report outlines the procedures used to answer these questions, a summary of the results, and their implications.

FIGURE 1. Levels of Use of the Innovation

LEVELS OF USE		DEFINITION OF USE
0	NONUSE	State in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.
I	ORIENTATION	State in which the user has recently acquired or is acquiring information about the innovation and/or has recently explored or is exploring its value orientation and its demands upon user and user system.
II	PREPARATION	State in which the user is preparing for first use of the innovation.
III	MECHANICAL USE	State in which the user focuses most effort on the short-term, day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet user needs than client needs. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.
IVA	ROUTINE	State in which use of the innovation is stabilized. Few if any changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.
IVB	REFINEMENT	State in which the user varies the use of the innovation to increase the impact on clients within immediate sphere of influence. Variations are based on knowledge of both short- and long-term consequences for clients.
V	INTEGRATION	State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.
VI	RENEWAL	State in which the user reevaluates the quality of use of the innovation, seeks major modifications of or alternatives to present innovation to achieve increased impact on clients, examines new developments in the field, and explores new goals for self and the system.

Excerpted from The LoU Chart
Procedures for Adopting Educational Innovations Project
Research and Development Center for Teacher Education
The University of Texas at Austin

Research Design and Procedures

Research Questions

The following research questions were asked:

1. How are Levels of Use distributed across a population assumed to contain both users and nonusers of individualized instruction?
   a. Is every LoU represented?
   b. Is the LoU distribution the same for individualized reading and individualized math?
   c. Is the LoU distribution the same for second- and fourth-graders?
   d. Is the LoU distribution the same for IGE and non-IGE schools?
2. What is the relationship between the teacher's LoU of individualized instruction and student achievement?
   a. Is there a difference in student achievement between users and nonusers of individualized instruction as defined by LoU (for math/reading, second/fourth)?
   b. Is there a difference in student achievement between teachers at different LoU's?
   c. Is there evidence that a linear or other systematic relationship exists between LoU and student achievement?
   d. How do the variables of Title I/non-Title I and IGE/non-IGE affect the relationship between student achievement and LoU?

Operational Definitions

Several terms used in this study require operational definitions. Reading and math achievement were measured by the California Achievement Test Battery Verbal/Comprehension Test and Mathematics Test (1970 Edition), respectively. Levels of Use, described earlier, was measured by the Levels of Use Interview (Loucks, Newlove, & Hall, 1975); nonusers of the innovation are individuals at LoU 0, I, and II; users of the innovation are individuals at LoU III and above. Individualized instruction was broadly defined as instruction planned and implemented with the needs of the individual child as the focus. Innovation was also defined broadly, as an identifiable program or process that requires observably different behaviors of the individual implementing it.

Sample

The sample for this study consisted of teachers from 21 schools of the Austin Independent School District. Ten of these schools were involved in Individually Guided Education (IGE), a complex innovation developed at the Wisconsin Research and Development Center that included individualized instruction, team teaching and multiage grouping. The other 11 schools had been selected by the A.I.S.D. Office of Evaluation as comparison schools, matching each with an IGE school with respect to geographic location, socioeconomic level, ethnic composition and size. The sample included eight Title I schools, schools receiving Title I funds, balanced with respect to IGE and non-IGE. These schools were below the district average in the percent of families below the poverty level, and so guaranteed that the sample contained a range in socioeconomic level. This particular sample

was selected because it provided a large enough number of teachers to be divided into the eight groups necessary for analysis by Levels of Use, and because there was a good chance that both use and nonuse of individualized instruction would be represented.

Since achievement test scores were necessary for the second set of research questions, the study was conducted with teachers of children who would be tested during the semester of the study. Thus, second- and fourth-grade teachers were identified as the sample.

Second- and fourth-grade teachers in each of the 21 schools were interviewed, totaling 133. This sample was used to answer the first set of research questions, those focusing on distribution of Level of Use.

In order to study the second set of research questions, those dealing with the relationship between Level of Use and achievement, certain conditions were necessary. The teacher had to have been responsible for the same students since at least November 1st; s/he had to be teaching the content area (reading/math) that was being interviewed for; and the teacher had to provide current class rolls for both reading and mathematics classes so that individual student achievement scores could be obtained. When these conditions were imposed, the sample for study of the second set of research questions was composed of 35 teachers for reading and 32 teachers for mathematics.

Measures

Level of Use Interview. The Level of Use Interview was developed at the Research and Development Center for Teacher Education at the University of Texas at Austin. It is a "focused" interview whose function is to solicit sufficient information from individuals to place them at a Level of Use with respect to a specific innovation. The interview is generic in nature: that is, the same questions can be used for any innovation simply by changing the focus. It is tape recorded and can be rated for LoU by independent coders, if desired. The LoU Interview and procedures for its use are described in detail in the Interview Manual (Loucks, Newlove, & Hall, 1976).

In a large-scale research effort employing the Level of Use Interview, interrater reliabilities ranged from 0.87 to 0.96. Percentage agreement on the overall LoU ranged between 60% and 70%. Since the present study was undertaken before refinement of the interview procedure, some of the interrater reliabilities and percentage agreements were lower than these values. Reliability coefficients were determined at three times during the tape rating period using Ebel's (1951) "formula for intraclass correlation," facilitated by computer program INTRAR (Veldman, 1974). These averaged 0.85. Percentage agreement on LoU averaged 60%.

California Achievement Test. The California Achievement Text (C.T.B./McGraw-Hill, 1970) is a norm-referenced test battery. Two of the tests, Mathematics and Verbal/Comprehension, are administered yearly to second- and fourth-grade students in the Austin Independent School District. The reliability of both tests, as summarized by Kuder-Richardson Formula 20 coefficients, shows a range of from 0.93 to 0.96 for different nation-wide samples. This particular test was chosen because it was given to all the students of the large sample of teachers necessary for the present study.

Procedures

Data collection for this study involved interviewing teachers and subsequent coding of the taped interviews to determine Level of Use of individualized instruction. The interview questions were actually repeated twice, once focusing on the teacher's reading instruction and once on mathematics instruction.

Two individuals rated each interview tape according to the procedures outlined in the interview manual. The average reliability coefficient was reported earlier. If there was a disagreement in overall LoU, a third rater listened to the tape and rated it. This was necessary for 40% of the tapes, since there was 60% agreement between the first two raters. Of that 40%, 62% were disagreed upon by only one Level of Use. Ninety-five percent of those disagreed on were resolved by a third rater; the remaining 5% were resolved by concensus reached through discussion.

Statistical Treatment

The first set of research questions, those dealing with Level of Use distributions, were answered by arithmetic calculation of distributions and percentages of the different groupings of interest. The second set of research questions, which compared achievement scores across Levels of Use, utilized one-tailed one-way analyses of variance and trend analyses. In conducting these analyses, student scores were chosen as the unit of analysis rather than teacher mean. This was done for several reasons: (1) the focus of the research questions was on the achievement of students of teachers at each LoU, (2) using the small teacher N available would have greatly reduced the power of the analyses, and (3) using a single mean for each teacher would have limited the amount of information that was obtained using several scores, including variation in achievement within a single classroom.

Results

Research Question 1: Distribution of Levels of Use

Figure 2 illustrates the LoU distributions for the two innovations (individualized reading and individualized math). In general, it can be seen that a higher percentage of teachers individualize reading than individualize math (i.e., the percent of users, LoU III or above, is 72% for reading and 62% for mathematics). Among nonusers (LoU 0 - II), the highest percent of teachers are at LoU I Orientation, and among users the highest percent are at LoU IVA Routine. There were no teachers in this sample at LoU VI Renewal.

Figure 3 compares the LoU distributions for second and fourth grades. These appear similar, although a slightly smaller percent of second-grade teachers are at LoU I Orientation and LoU IVA Routine.

Figures 4 and 5 illustrate LoU distributions for IGE and non-IGE schools for individualized reading and individualized math, respectively. The most outstanding feature of these two graphs is that both IGE and non-IGE teachers appear at each LoU (except LoU VI Renewal where there were no teachers at all). Although for each innovation the percent of IGE users was higher than non-IGE users, there was a significant number of users in non-IGE schools. For both innovations also IGE teachers tend to spread over the user Levels moreso than non-IGE teachers who are predominantly at LoU IVA Routine. A significant percent of non-IGE teachers are orienting themselves to individualized instruction (i.e., are at LoU I Orientation).

FIGURE 2. Distribution of Levels of Use of Individualized Instruction in Reading and Mathematics

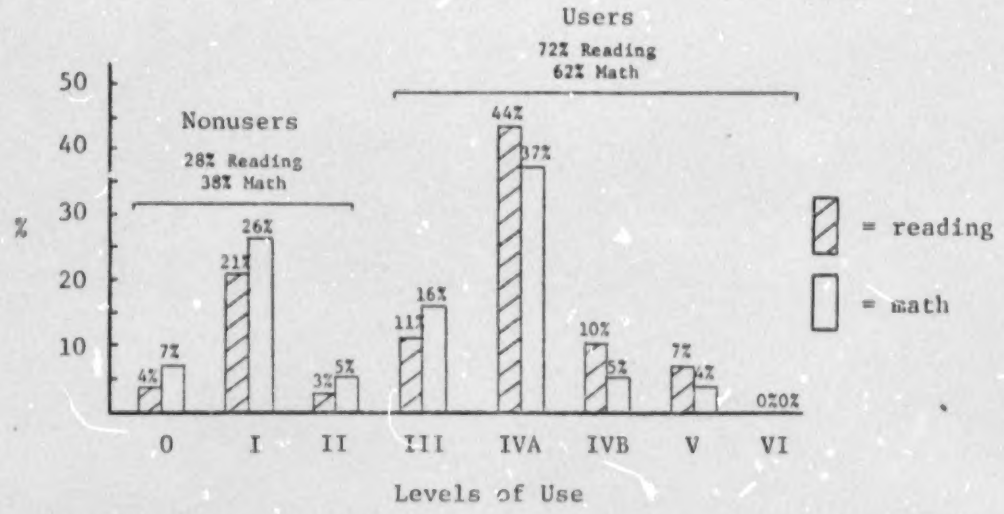


FIGURE 3. Distribution of Levels of Use of Individualized Instruction in Second and Fourth Grades

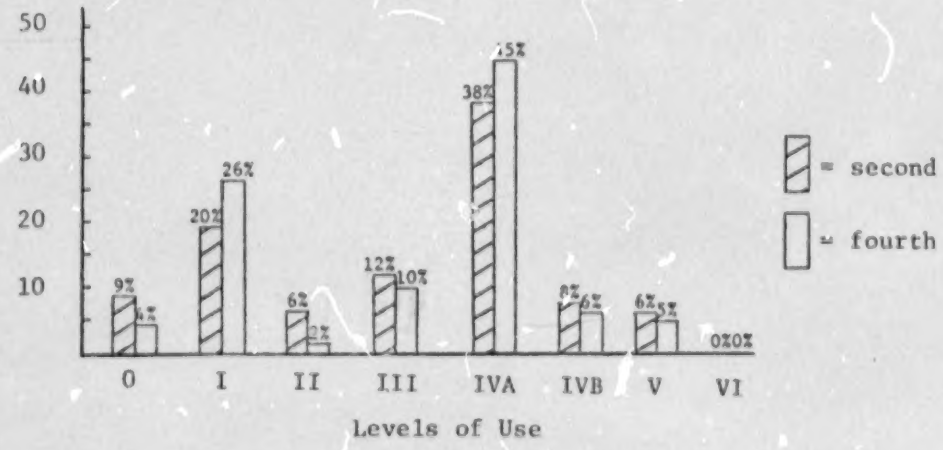


FIGURE 4. Distribution of Levels of Use of Individualized Instruction in Reading in IGE and Non-IGE Schools

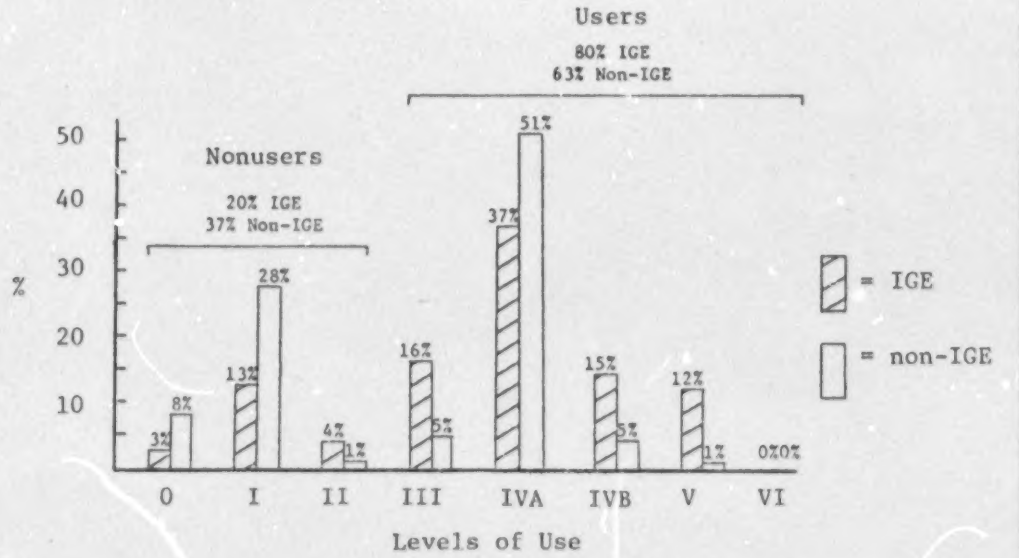
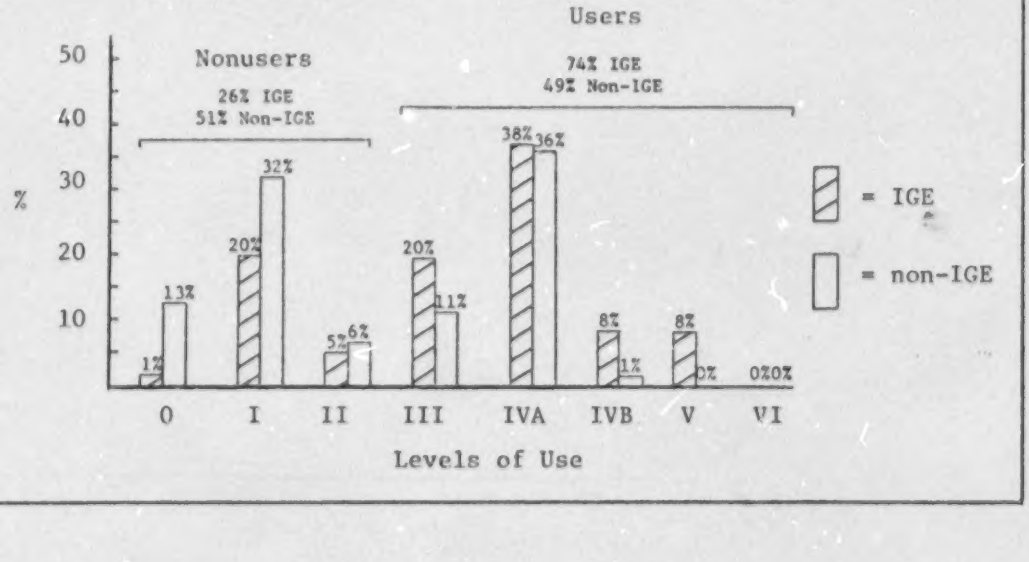


FIGURE 5. Distribution of Levels of Use of Individualized Instruction in Mathematics in IGE and Non-IGE Schools



Research Question 2: The Relationship of Levels of Use to Student Achievement

Two major sets of analyses were conducted in response to Research Question 2. First, comparisons of achievement scores were made between nonusers and users of individualized instruction for the two content areas and the two grade levels. As illustrated in Table 1, significant differences were found for each comparison.

TABLE 1. Group Means for Use/Nonuse Comparison

Grade Level	Content Area	Mean for Nonusers	Mean for Users
Second Grade	Reading*	40.27	50.03
	Math*	59.34	63.57
Fourth Grade	Reading*	49.35	37.69
	Math*	48.29	56.39

*significant at the .01 level

As indicated in Table 1, students of users of individualized instruction showed greater achievement than those of nonusers in every case except fourth grade reading when the opposite was true. However, further analyses which accounted for the SES level of the school, dividing the sample into Title I and non-Title I schools, indicated that these significant differences did not occur for second grade math (both Title I and non-Title I) and for fourth-grade math Title I only.[4]

The other major set of analyses compared student achievement across teacher Level of Use. Every comparison showed significant differences between LoU. Figure 6 illustrates graphically these differences. As shown by this figure, a great deal of variation in achievement exists between teacher Levels of Use. Except for fourth grade reading, achievement appears to be higher for users (LoU III and above). Among users, except for fourth grade mathematics, there appears to be a tendency for LoU III Mechanical to be low, then increase for LoU IVA Routine, decrease again at LoU IVB Refinement and increase again for LoU V Integration. Fourth grade math appears to have the opposite trend, peaking instead at LoU III Mechanical and IVB Refinement.

An exploratory test for systematic differences was conducted on the second grade data. As illustrated in Figure 7, trend analyses indicated that the best fit curves for the relationship between LoU and student achievement were quadratic. However, although these are the best fit curves, there is a fairly low correlation between the variables (0.28 for reading and 0.17 for math), indicating that student achievement differences for teacher LoU's are at best weakly systematic. This is corroborated by Figure 6.

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[4]Further analyses using the Title I and non-Title I variable are included in the longer version of this report.

FIGURE 6. Second and Fourth Grade Reading and Mathematics Group Means for Comparison of Teacher Level of Use of Individualization and Student Achievement

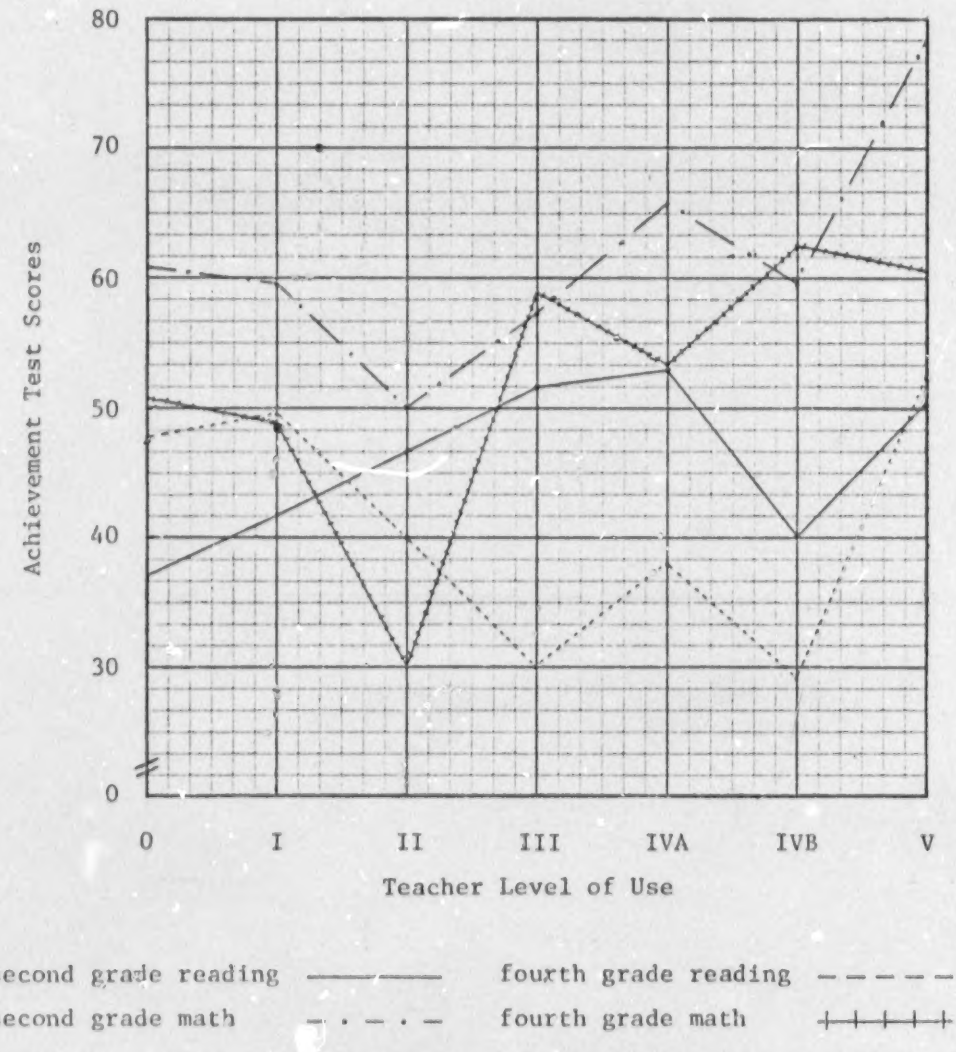
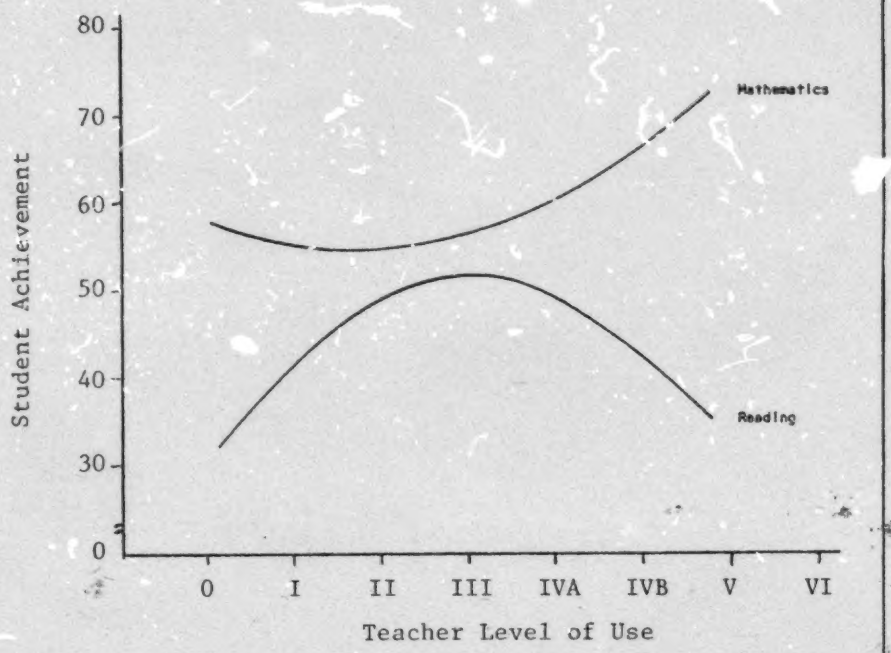


FIGURE 7. Best Fit Curves for the Relationship Between Teacher Level of Use of Individualized Instruction and Student Achievement at the Second Grade Level



A further set of analyses were conducted to test whether there were achievement differences between students in IGE schools and those in non-IGE schools. No significant differences were found. Table 2 illustrates the means.

TABLE 2. Group Means for IGE/Non-IGE Comparison

Grade Level	Content Area	Mean for IGE	Mean for Non-IGE
Second	Reading	44.47	43.91
	Math	57.30	59.56
Fourth	Reading	42.40	41.64
	Math	53.35	53.68

Discussion

Before drawing conclusions and citing implications from this study, several cautions must be communicated. First, Levels of Use is a concept that was still under validation when this study was conducted; the LoU Interview was still in the process of refinement. Therefore, the interrater agreements were not as high as they might have been had the study been done six months later. Second, the number of teachers used for the achievement comparisons was low, particularly for some Levels of Use. Therefore, although the number of student scores was high enough for significant differences to occur, the probability is increased that characteristics of individual teachers other than LoU influenced the outcomes. Finally, this study involved a "posttest only" design, and so suffered from the lack of information about initial student achievement status; thus it is impossible to infer causality and difficult to generalize. It is emphasized that this was an exploratory study that did not propose to generalize, but to look for tendencies and interactions within a given sample.

The LoU distributions reported in response to the first set of research questions indicate several interesting tendencies. The majority of individuals in the sample, which was assumed to contain a range of Levels of Use, were at LoU I Orientation and LoU IVA Routine. The tendency for these LoU to predominate is found in other LoU research (Hall & Loucks, 1976). The tendency was the same for both grade levels, both innovations and IGE and non-IGE schools. This information may be helpful to decision makers who may value some LoU's over others, who may prefer to have teachers move on to actually preparing to use an innovation (LoU II Preparation) from LoU I Orientation, or to have more teachers attain higher LoU's than LoU IVA Routine.

Another interesting tendency in the LoU distributions is the number of users of individualized instruction in non-IGE schools and nonusers in IGE schools. Since individualization is an important component of IGE, it might be assumed that IGE schools should have all users and non-IGE schools all nonusers. This illustrates well the problem of relying on a label or the word of an administrator to tell what is happening in a school, rather than going directly to the classroom level and the teacher for information. In this sample, as far as individualization is concerned, there is not that much difference between IGE and non-IGE schools. This especially creates a problem in evaluating a program such as IGE, where comparisons are typically made between IGE and non-IGE schools. As noted in the data for the second research question, there was no significant difference in achievement between IGE and non-IGE schools in this sample. However, there were differences between users and nonusers of individualization, an important component of IGE. Looking in depth at this sample, through the concept of LoU, revealed significantly more information than conducting a classic evaluation of IGE.

Other tendencies indicated by this study are in relationships of LoU to achievement. The many analyses conducted indicate that there are significant differences in student achievement between teachers at different Levels of Use. These differences may be unique to the innovation and the grade level; there may be a pattern of fluctuation in achievement as teachers change LoU's, particularly among users, as discussed previously. Identification of the pattern or patterns requires further investigation with a larger sample and with other innovations. The results of this study indicate, however, that much can be discovered from studying the LoU of a sample of teachers, and that student achievement does vary, if not altogether systematically, with teacher LoU.

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